

Chapter 3: Turning Off Cancer

Taylor Kollak, Brittany Arnold, & Emily Mohs

Americans dread cancer more than any other disease.

3 Stages of Cancer:

- 1. Initiation**
 - "Plant seeds in the soil"
- 2. Promotion**
 - "Grass starts to grow"
- 3. Progression**
 - "Grass gets completely out of control, invading the driveway, shrubbery, and the sidewalk"



The Science of Cancer

Carcinogens: genetically transform, or mutate, normal cells into cancer-prone cells

"Process the successfully 'implants' the grass seed in the soil"

- **Several chemicals have been identified by popular press as cancer-causing agents:**
 - Aminotriazole
 - Dichlorodiphenyltrichlorethane (DDT)
 - Nitrites
 - Red Dye Number 2
 - Some Artificial Sweeteners
 - Dioxin
 - Aflatoxin

Effect of Dietary Protein on Enzyme Activity

How does protein affect cancer initiation?

- Mixed function oxidase (MFO) enzyme, responsible for aflatoxin metabolism.
- Enzyme activity could be easily modified simply by changing the level of protein intake.
- Decreasing protein intake 20%-5% quickly decreased enzyme activity.
- Low protein intake could markedly decrease enzyme activity and prevent dangerous carcinogen binding to DNA



THE ENZYME "FACTORY"

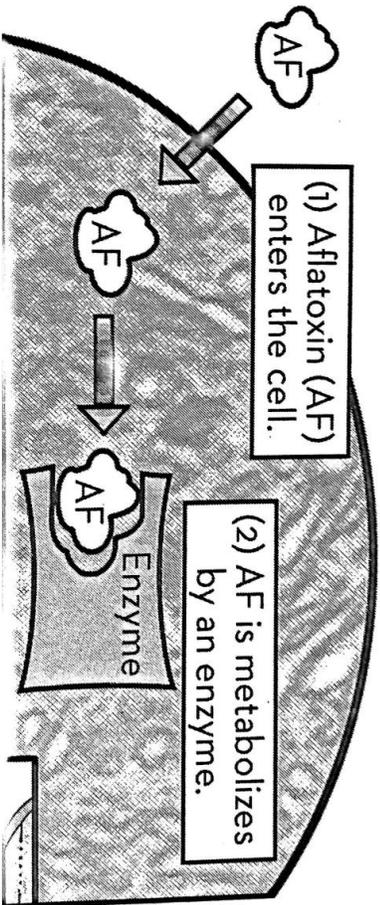


Chart 3.2: Effect of Dietary Protein on Enzyme Activity

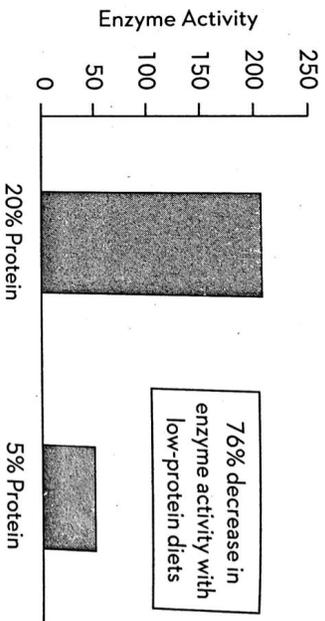
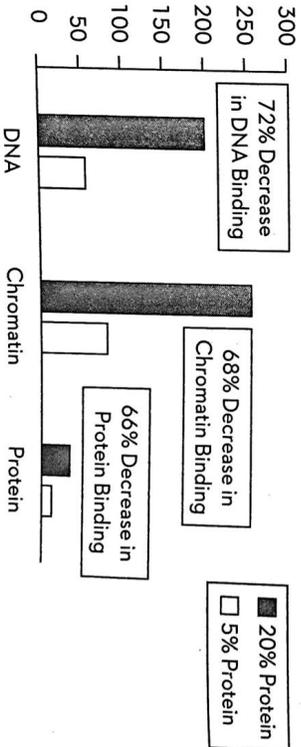


Chart 3.3: Decrease in Carcinogen Binding to Nucleus Components Caused by Low-Protein Feeding

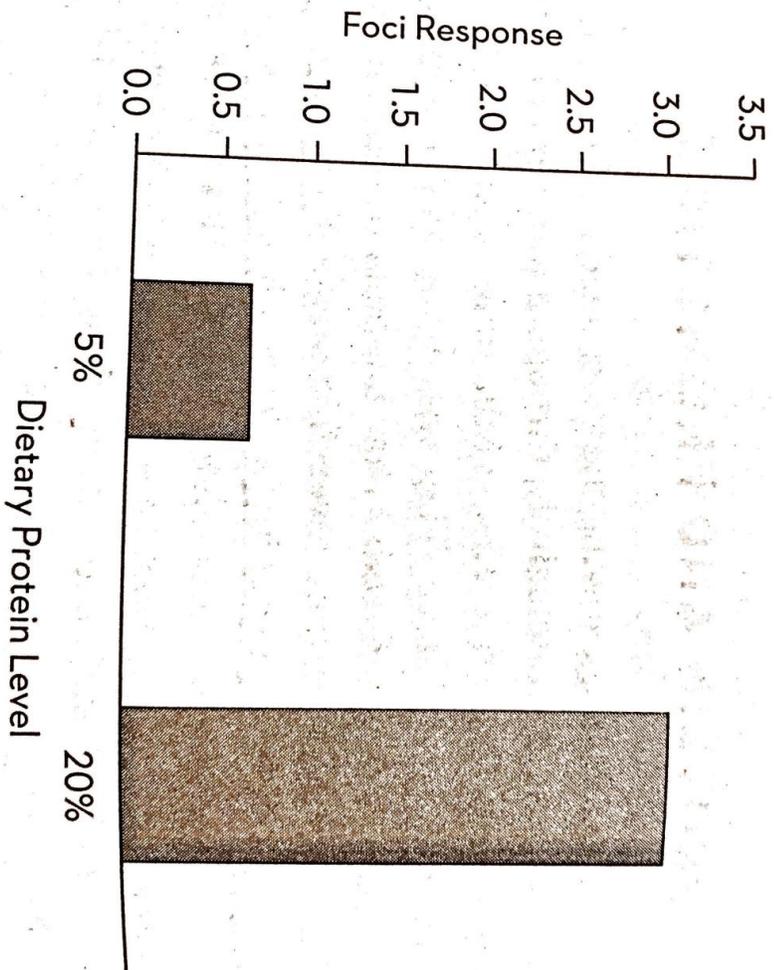


Dietary Protein & Foci Formation

- **Foci** – clusters of cancer-like cells that grow into tumors
 - Not full-blown tumor cells but can be predictive of tumor development
- Protein related to promotion of foci helps avoid time and money spent in the lab
- Foci development dependent on how much protein was consumed, regardless of how much aflatoxin was consumed
- Foci grew more with the 20% protein diet than with the 5% protein diet



Chart 3.4: Dietary Protein and Foci Formation

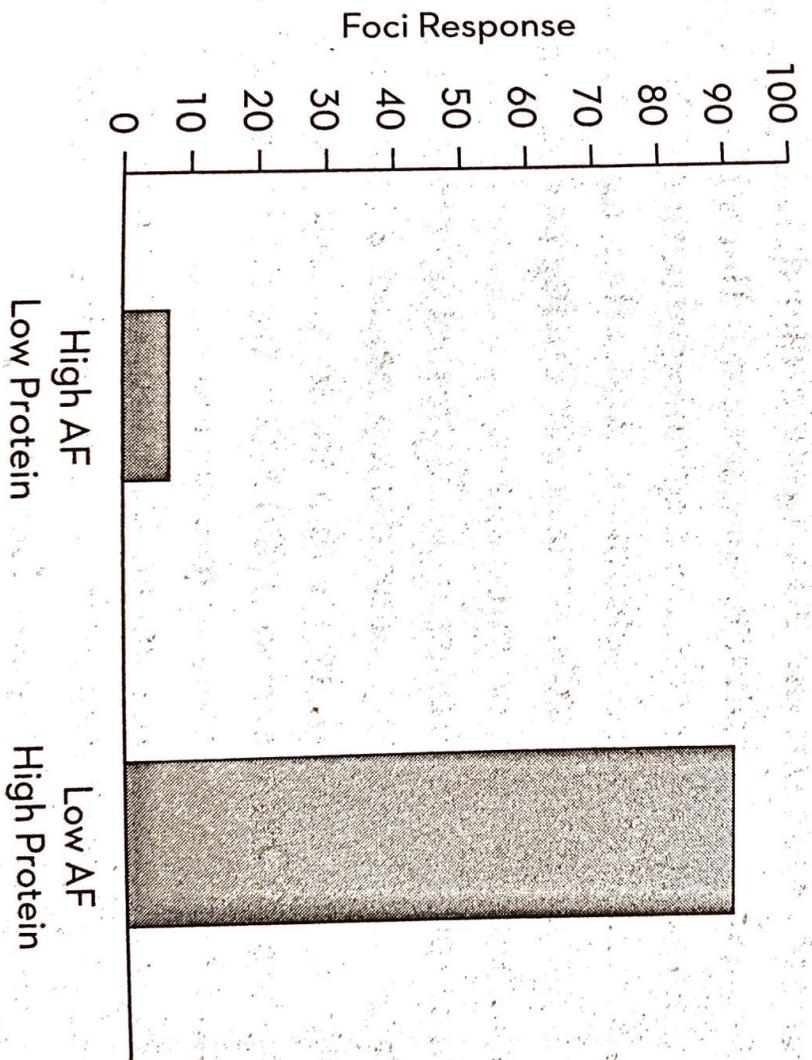


Carcinogen Dose Versus Protein Intake

- Two Groups:
 - High aflatoxin dose
 - Low aflatoxin dose
- Rats started cancer process with different amounts of initiated, cancerous "seeds"
- Low-protein diet (5%) - high aflatoxin group
 - Less foci produced
- High-protein diet (20%) - low aflatoxin group
 - More foci produced
- Foci development found to be controlled by amount of dietary protein consumed during promotion stage



Chart 3.5: Carcinogen Dose Versus Protein Intake



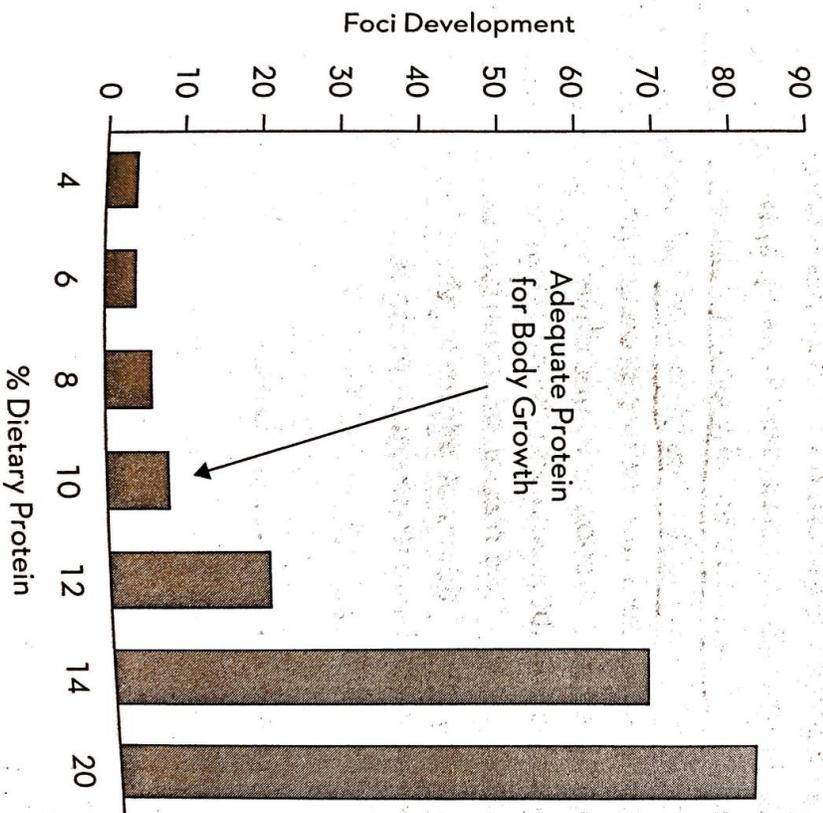
Foggi Promotion by Dietary Protein

- Recommend Dietary Allowance (RDA) for protein is 10% of daily calories
- Difference between "requirement" and "recommendation"
- Average American consumes 15-16%
- Government recommends levels as high as 17-21%

Does this place us at risk for cancer?



Chart 3.6: Foci Promotion by Dietary Protein

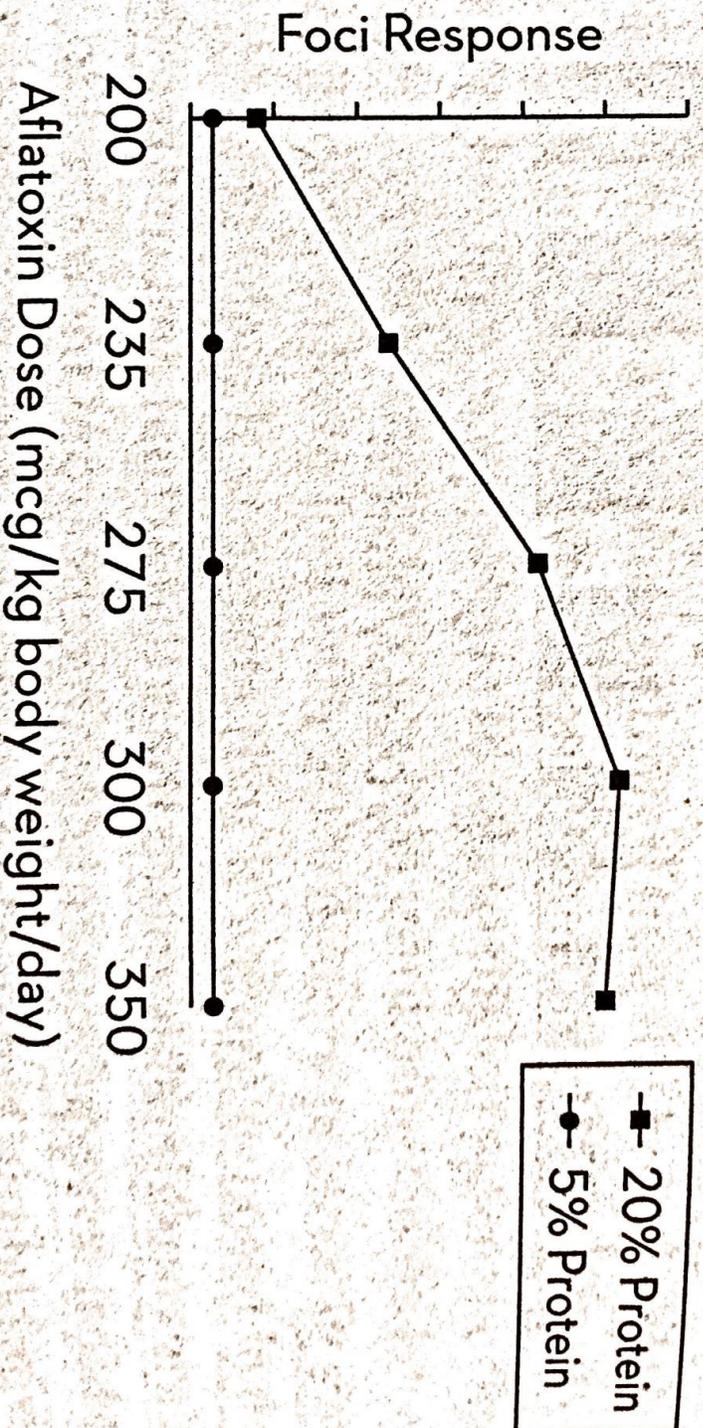


Protein related to aflatoxin dose & foci formation

- A chemical is usually not considered a carcinogen unless higher doses yield higher incidences of cancer.
- 10 groups of rats
 - Given increasing doses of aflatoxin
 - Fed either regular (20%) or low (5-10%) of protein
 - Promotion period
- Results
 - 20% protein group: foci increased as dose increased
 - 5% protein group: foci did not appear as dose increased



Chart 3.7: Aflatoxin Dose—Foci Response

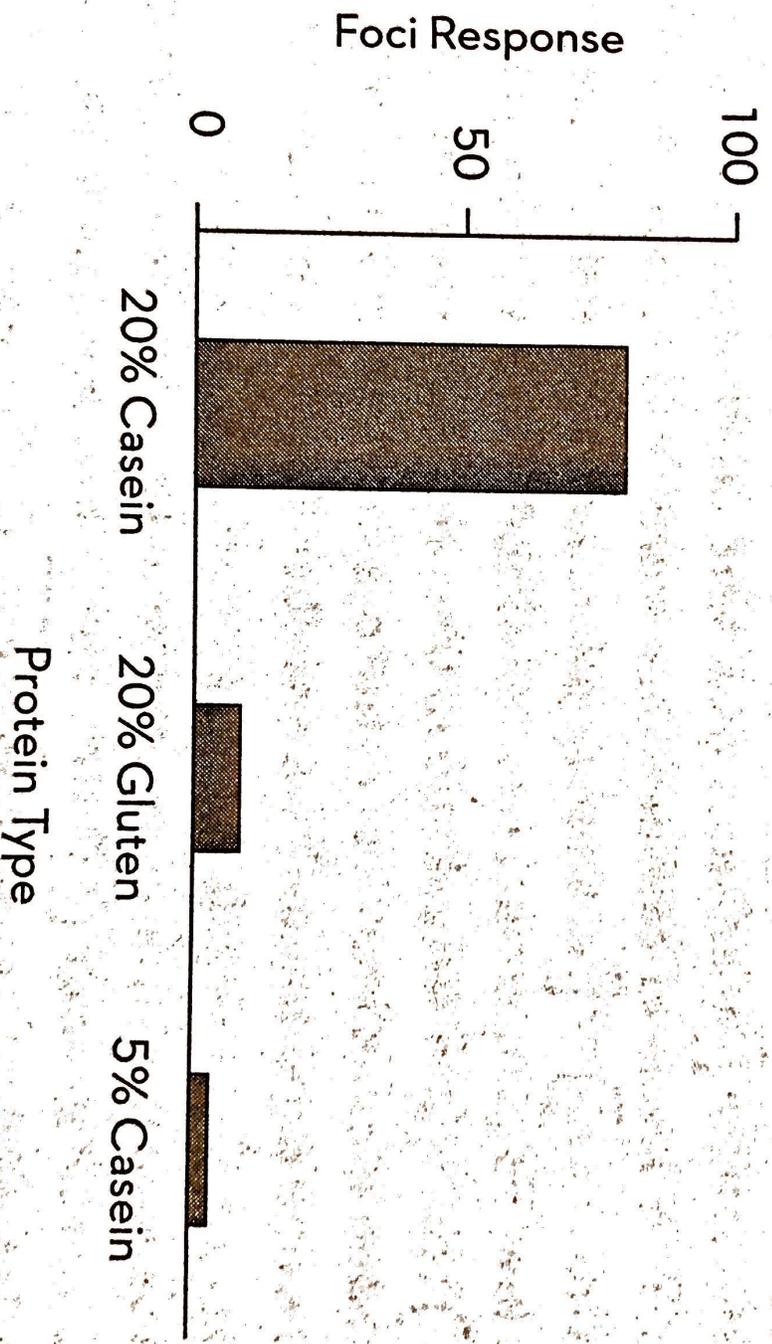


Not all proteins are alike.

- Does plant protein, tested in the same way, have the same effect on cancer promotion as casein?
 - Casein (80-85% cow's milk protein)
 - Gluten (plant protein)
 - Soy protein
- The answer is an astonishing "NO."
- Gluten & soy protein did not produce the same result as casein, even when fed at the same 20% level.
- In this case, casein is the cancer-promoting factor in addition to the amount of protein intake.

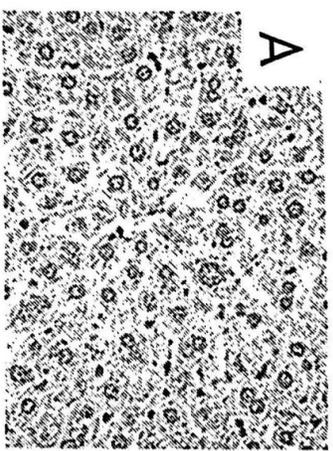


Chart 3.8: Protein Type and Foci Response

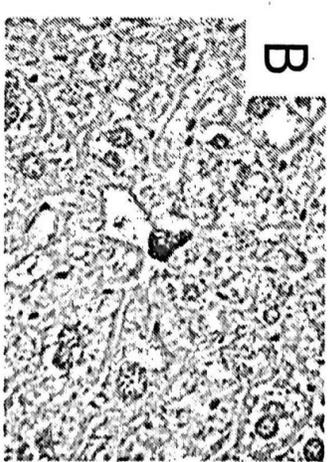


Effect of casein on HBV-induced liver cancer in mice

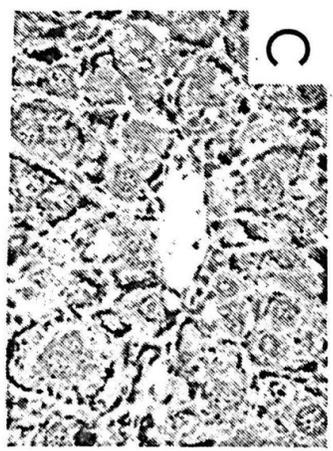
Non-transgenic Mice
(Control) with 22%
Casein Diet



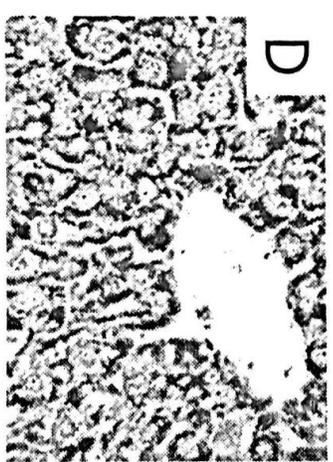
Transgenic Mice with
6% Casein Diet



Transgenic Mice with
14% Casein Diet

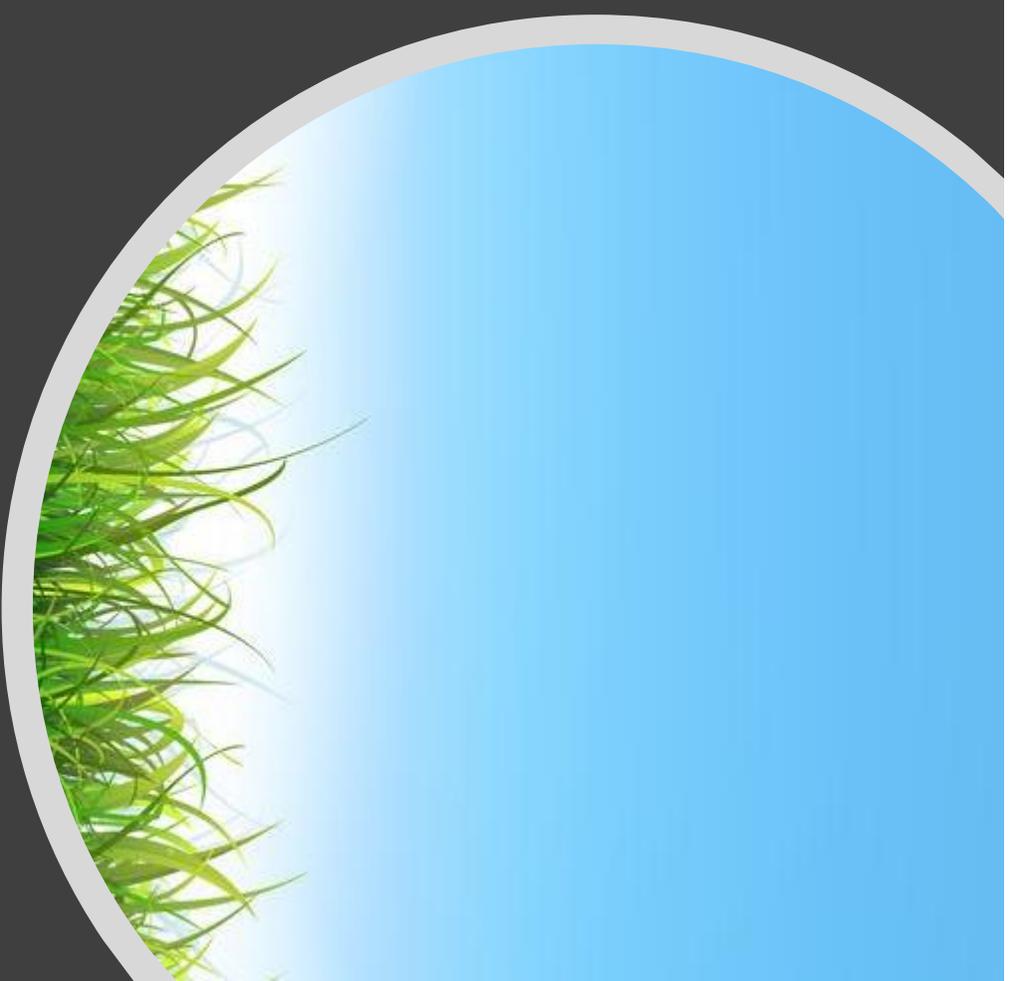


Transgenic Mice with
22% Casein Diet

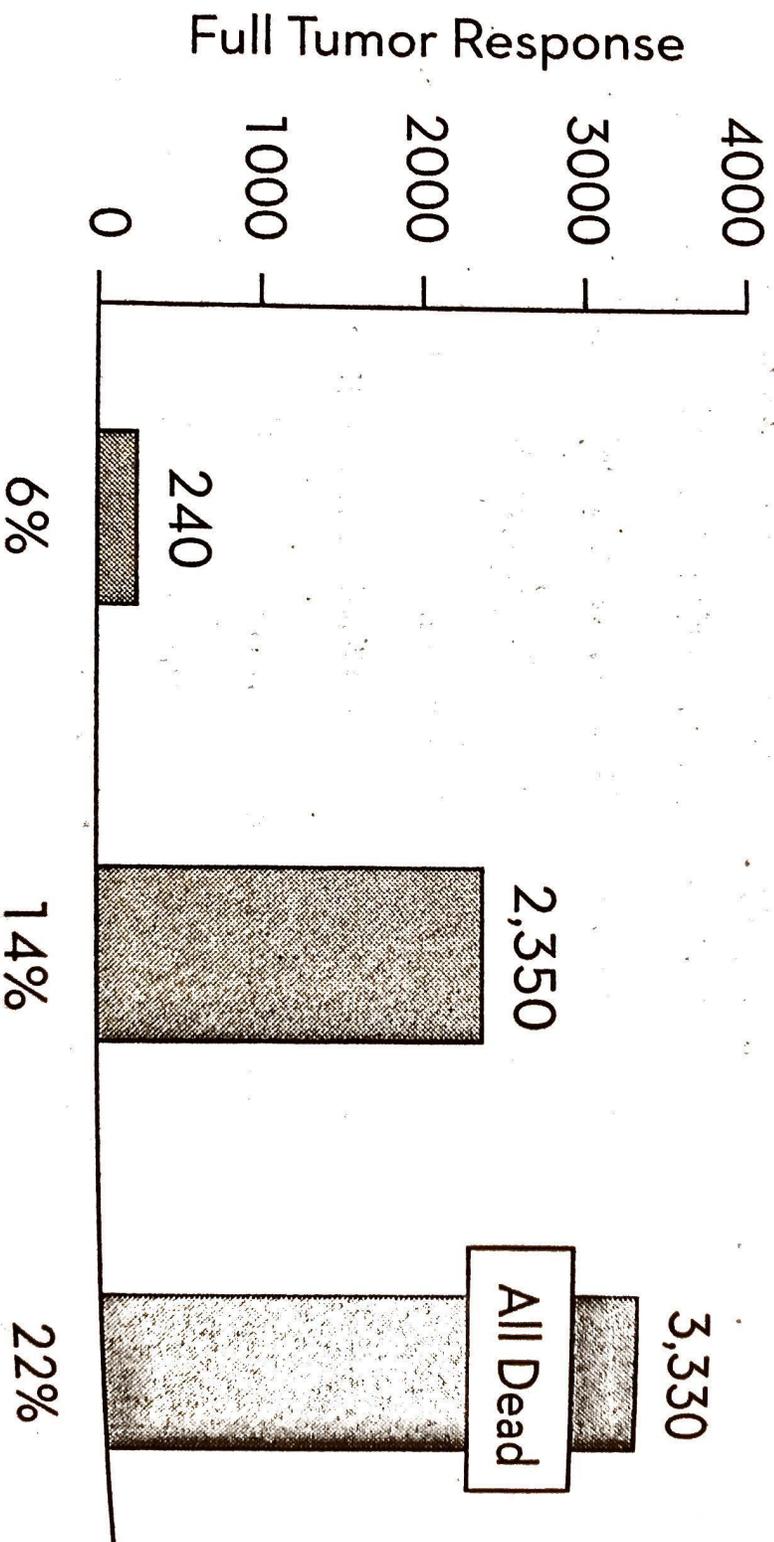


The Grand Finale

- 100-week study on complete tumor formation in rats
 - Rats given aflatoxin & 20% levels of casein were either dead or near death from liver tumors
 - Rats given aflatoxin & 5% levels of casein were alive and active
- Diet switch
- High-protein group who switched to low-protein has 35-40% less tumor growth
- Nutritional manipulation can turn cancer "on" and "off"



*Chart 3.9a: Tumor Development at 100 Weeks



Pros and Cons with Animal Experiments

PROS

- Rats & humans have an almost identical need to protein
- Protein operates in humans virtually the same way it does rats
- The level of protein intake causing tumor growth is the same level that humans consume
- There is no adequate alternative to testing on a live, whole-body system

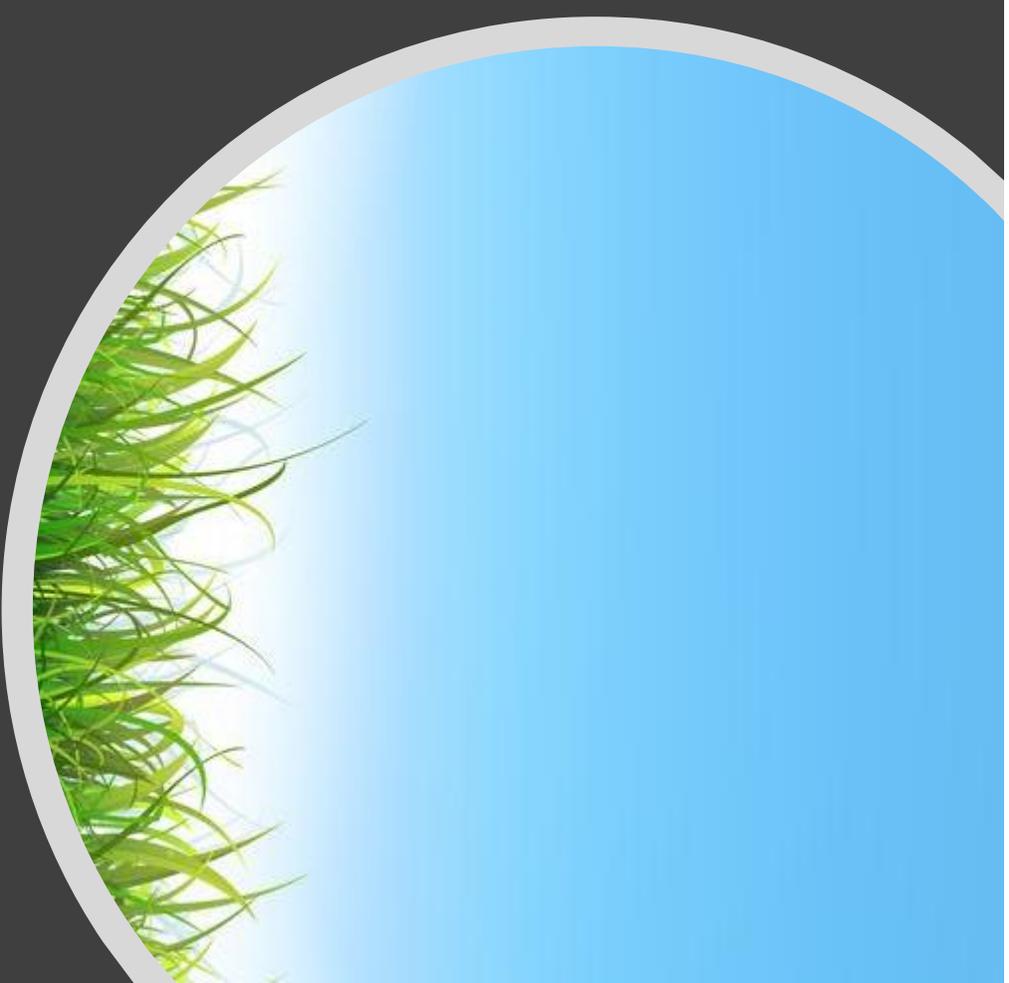
CONS

- Alternative ways to get the information
- Cruel and inhumane treatment
- It can be expensive
- Most animals used in testing and research are not protected by the Animal Welfare Act (AWA)



Key points

- Nutrition showed to be more in control than dose of the initiating carcinogen
- Animal-based food increased tumor development
- Plant-based food decreased tumor development



Problem Statement

Are these principles regarding animal protein and cancer critically important for all humans in all situations, or are they merely marginally important for a minority of people in unique situations?

Reference

- Campbell, T. C., & Campbell II, T. M. (2016). *The China Study*. Dallas, TX: BenBella Books, Inc. .